Downy Mildew in Cucurbits

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Factsheet

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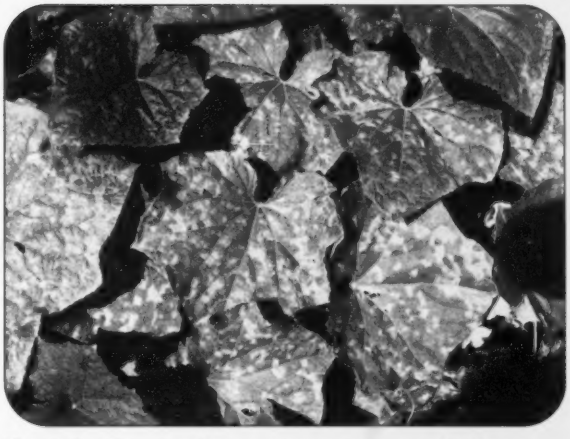

Figure 1. Downy mildew symptoms on cucumber leaves.

Figure 2. Leaves of cucumber plants severely infected with downy mildew eventually turn brown and curl, giving the plant a brown, crisp appearance. Unprotected cucumber fruit often develop sun scald and are not marketable.

INTRODUCTION

Downy mildew is a serious disease of cucurbit crops grown in Ontario (Figure 1). It is caused by the fungus-like water mould *Pseudoperonospora cubensis*. Once established in a region, the disease can spread rapidly, causing significant loss of fruit quality and yield.

Table 1. Interaction of cucurbit host with different pathotypes (strains) of downy mildew

Host	Pathotype (strain)					
	1	2	3	4	5	6*
Cucumber	+	+	+	+	+	
Cantaloupe	–	+	+	+	+	+
Sweet melon	–	+	+	+	+	
Sour melon	–	–	+	+	+	
Watermelon	–	–	–	+	+	–
Pumpkin and squash	–	–	–	–	+	+

* 6th pathotype identified in Israel in 2003
+ indicates infection and disease
– indicates no or very little disease
(modified from *Compendium of Cucurbit Diseases*, APS Press, St. Paul MN)

Downy mildew infects gourds, squash, pumpkins, melons and cucumber. Cucumbers are the most susceptible crop to this pathogen. Several different strains (pathotypes) of this organism have been identified (Table 1). The downy mildew pathogen tends to be specific to crops within a plant family. The pathogen that causes downy mildew in cucurbits will not infect legumes or spinach and vice versa.

The downy mildew pathogen primarily infects the leaves, resulting in decreased photosynthesis. During favourable environmental conditions (see *Biology*), the pathogen can defoliate plants and destroy entire fields within a week.

Fruit of infected plants are usually undersized and misshapen. They are also more likely to develop sun scald, which further reduces their quality (Figure 2).

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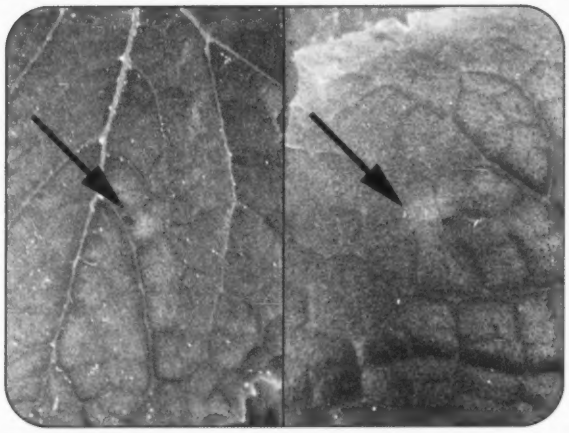

Figure 3. Small yellow "greasy" spots on the topside of leaves (left) are often the first symptom of downy mildew infection. The yellow spot eventually develop a tan brown necrotic center as the lesion matures (right).

SYMPTOMS

Downy mildew symptoms first appear as small yellow spots or water-soaked lesions on the topside of older leaves (Figure 3, left). The centre of the lesion eventually turns tan or brown and dies (Figure 3, right). The yellow spots sometimes take on a "greasy" appearance and do not have a distinct border. During prolonged wet periods, the disease may move onto the upper crop canopy.

In cucumbers, the lesions are often confined by leaf veins and appear angular in shape (Figure 4). In cantaloupe crops, the lesions appear irregular shaped (Figure 5), whereas the lesions are smaller and rounder on infected watermelon leaves (Figure 6). As the disease progresses, the lesions expand and multiply, causing the field to take on a brown and "crispy" appearance.

Under humid conditions, the lesion often develops a downy growth on the underside of the light yellow lesions observed on the top of the leaf. This downy growth is particularly noticeable in the mornings after a period of wet weather or when conditions favour dew formation. The downy growth on the underside of the lesions is frequently speckled with dark purple to black sporangia (spore sacks) that can be observed with a hand lens (Figure 7). The presence of the downy growth on the underside of the lesion is a key to diagnosing this disease. Lesions are sometimes invaded by secondary pathogens such as soft rot bacteria or other fungi.

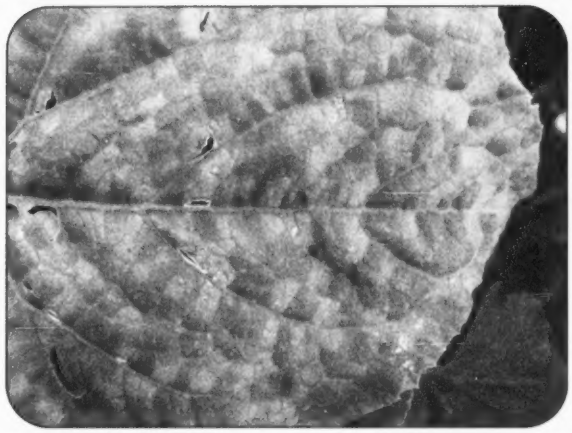

Figure 4. Expanding lesions on cucumber leaves are often restricted by leaf veins, giving the lesion an angular or square appearance.

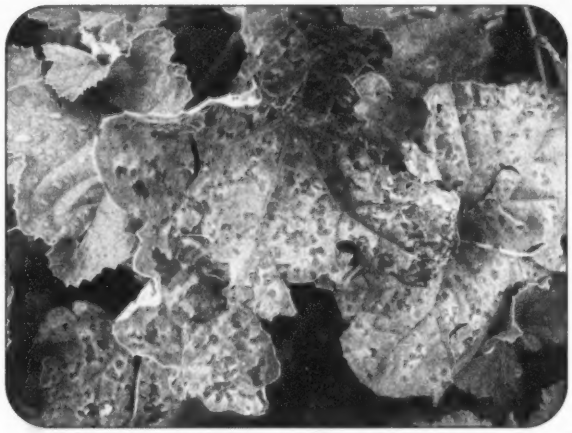

Figure 5. Downy mildew lesions on the upper surface of melon leaves appear irregular shaped.

Figure 6. Downy mildew lesions on watermelon leaves appear smaller and rounder than on cucumber or cantaloupe leaves.

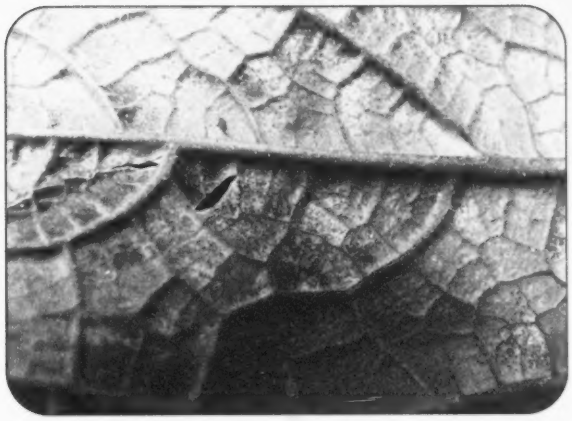

Figure 7. Sporangia (spore sacks) in the lesions on the underside leaf surface appear as black specks.

Due to the rapid spread of this disease and because symptoms often do not appear until 4–12 days after infection, **a successful disease management program must be implemented prior to the appearance of the disease symptoms.**

BIOLOGY

Downy mildew is favoured by cool, wet and humid conditions. The pathogen produces microscopic sac-like structures called sporangia over a wide range of temperatures (5°C–30°C). Optimum sporangia production occurs between 15°C–20°C and requires at least 6 hours of high humidity. The sporangia act similar to spores. They are easily transferred to healthy plant tissue by air currents or splashing rain. Once they land on a susceptible host, they germinate and can directly infect the leaf within one hour. During prolonged cool wet periods, the sporangia can also burst open and release many zoospores. The zoospores swim through the film of water along the leaf surfaces towards the stomates. These natural pores are a primary point of entry for the pathogen, resulting in multiple infections on the leaf.

This disease may progress slowly or stop temporarily when temperatures rise above 30°C during the day. Nighttime temperatures of 12°C–23°C will promote disease development, especially when accompanied by heavy dews, fog or precipitation. With nighttime temperatures around 15°C and daytime temperatures around 25°C, downy mildew infections on cucurbits produce more sporangia within 4 days.

PATHOGEN SURVIVAL AND SPREAD

The downy mildew pathogen is an obligate parasite. It requires living green plant tissue to survive. Killing frosts and cold winters effectively prevent spores from overwintering in the field in Ontario. However, downy mildew can overwinter on living cucurbit plant material growing in greenhouses. Furthermore, greenhouse cucumber crops and transplants are at risk of developing downy mildew from wind-borne sources early in the spring, before the field crop has been planted.

Downy mildew primarily overwinters in the southern U.S. and Mexico where cucurbits are produced year-round. In these areas, the inoculum builds up on susceptible hosts in the early spring. Sporangia are carried long distances by storms and may survive for several days. Once the disease arrives in Ontario and becomes established in a region, sporangia are disseminated by air currents, splashing rains, overhead irrigation, insects, tools, farm equipment, the clothing of workers and through the handling of infected plants.

The Cucurbit Downy Mildew Forecast is a web-based downy mildew forecasting system that follows the movement of downy mildew from the south to north throughout the growing season and alerts growers to the potential movement of the disease into a region. Following the movement of the disease throughout the growing season and adhering to the regional disease alerts allows growers to make timely fungicide applications. See http://cdm.ipmpipe.org.

MANAGEMENT STRATEGIES

Manage downy mildew using cultural practices integrated with registered fungicide applications:

- If possible, produce vegetable transplants in greenhouses dedicated solely to transplant production. Do not produce cucurbit transplants in the same greenhouse as mature greenhouse cucumber plants.
- When planting cucurbit transplants, ensure that the transplants are free from disease.
- Apply a fungicide on field-planted transplants prior to installing a row cover or tunnel and immediately after the row cover or tunnel is removed.
- Select fields and manage the crop to promote air movement and reduce humidity levels inside the crop canopy.
- Avoid excess overhead irrigation. Consider irrigating during the late morning to facilitate rapid leaf drying. Apply a preventative fungicide prior to an overhead irrigation event. If possible, use trickle irrigation.

- Scout fields for symptoms of the disease every week — more often if possible.
- Maintain good weed control in the field. Control alternate weed hosts (wild cucumber, goldencreeper and volunteer cucumbers) in neighbouring fence rows and field edges.
- Follow a preventative spray program. Consult OMAFRA Publication 363, *Vegetable Production Recommendations,* for registered fungicides that can be applied to control downy mildew. Under wet and humid conditions, apply a fungicide every 5–7 days. When dryer weather occurs, the interval between applications can be relaxed to 7–10-day intervals. Always apply fungicides with at least 250–300 L of water per hectare (25–30 gal/acre). Ensure adequate coverage and spray penetration into the canopy. Rotate between fungicides from different chemical families. Use both multi-site and single-site mode-of-action products.
- Consider washing equipment and tools before moving from one field to another.
- Ensure field workers wash their hands before moving from one field to another and, if possible, wear freshly laundered clothing each day.
- If possible, work in diseased fields at the end of the day.
- Monitor the Cucurbit Downy Mildew Forecast website to follow the movement of the disease throughout the growing season and make timely fungicide applications.

ADDITIONAL SOURCES OF INFORMATION

http://web.aces.uiuc.edu/vista/pdf_pubs/927.PDF

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